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10/791,334

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EXAMINER

TUROC, DAVID P

ART UNIT

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1792

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

| | | | |
|------------------------------|--------------------------------------|-----------------------------------|--|
| Office Action Summary | Application No. 10/791,334 | Applicant(s) KIM ET AL. | |
| | Examiner DAVID TUROCY | Art Unit 1792 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 July 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4,5,8,9,11,15,17,18 and 40-46 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4,5,8,9,11,15,17,18 and 40-46 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 7/13/2009 has been entered.

Response to Amendment

2. Applicant's amendments, filed 7/13/2009, have been fully considered and reviewed by the examiner. The examiner notes the amendment to claim 1, the cancellation of claims 2, 3, 6, 7, 10, 12-14, 16, and 19-25 and the addition of new claims 40-46. Claims 1, 4-5, 8-9, 11, 15, 17-18, and 40-46 are pending in the instant application.

Response to Arguments

3. Applicant's arguments filed 7/13/2009 have been fully considered but they are directed to newly amended claim limitations that were not present at the time of the prior rejection and thereafter the arguments are deemed moot.

The applicant has argued against the Park reference stating that the reference discloses at a maximum deposition rate of 17 angstroms per minute, however, this is incorrect. Park discloses TMA/H₂O deposition using 1.5 second pulses to deposit a film

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of 0.2 nm (2 Å/1.5sec) *60sec/min = ~90 angstroms per minute. Even the Table 3 discloses higher deposition rates, including the oxidation reduction process (which is not necessary for forming a film). See C which discloses a deposition rate of 40 Å/min as calculated using applicants own calculations). However, in each case of Table 3, the film is deposited at a rate of 60 angstroms per minute (2Å/2s *60/sec/min, where the process pulses TMA and H₂O at 1 second each) and the only difference is the placement of the oxidation treatment. The mere fact that Park discloses a subsequent oxygen reduction process does not remedy the fact that the prior art discloses two pulses of gases, using the same substrate, similar pressures, and similar pulse durations. Since the dose that results in maximum growth rate as in the applicant's claimed process is disclosed in the applicants own specification as simply a function of the precursors utilized and the length of pulses, and Park teaches the claimed process steps (including equivalent times and process gases), Park would have inherently produced a dose sufficient to results in a film growth rate at a maximum value unless essential process steps and/or limitations are missing from the applicant's claims. The mere observation of still another beneficial result of an old process cannot form the basis of patentability. *Allen et al. v. Coe*, 57 USPQ 136; *In re Maeder et al.* 143 USPQ 249. Therefore the fact that Park does not explicitly state that the process gases are supplied at a dose that results in maximum saturated deposition rate does not disqualify the reference because Park does discloses the claimed process steps (including equivalent times and process gases). At the very least selecting dose so as to reap the benefits of a maximum deposition rate would have been obvious to one of ordinary skill

in the art to reap the benefits of increase film deposition efficiency and thus increase throughput, a substantial benefit desired in the semiconductor processing industry.

Finally, with regards to the arguments against the maximum deposition rate being disclosed at 100-200 A/min, this is clearly not commensurate in scope with the claims, the claims fail to require any specific deposition rate, merely an alleged "maximum film deposition rate", which is dependent on the gases and the pulse times, as evidenced by the applicants specification Park discloses such with regards to TMA and water ALD deposition.

Again with regards to the Park reference, the reference discloses the same gases and the same pulse times and the applicant has disclosed the deposition rates and the properties as merely a function of the gases and the pulse times, and therefore the results must necessarily be the same as claimed, unless the applicant is performing other process steps that are not presently claimed.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 40, 41, and 46 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 40 and 41: The metes and bounds of a pulse time less than conventional ALD process is unclear. What are the times for traditional ALD process that the claimed pulses are being measured. The applicants have not defined such a term to enough

specificity. The applicants have disclosed pulse times of 0.2 to 2 seconds for the inventive concept and thus such times are being utilized as less than conventional ALD process.

Claim 46: Independent claim 1 requires deposition at "substantially maximum film deposition rate" and claim 46 then requires determining the pulse times to achieve film deposition rate greater than or equal to 50% of the maximum film deposition rate. It is unclear how both can be achieved at the same time. In other words, achieving substantially the maximum deposition rate appears to require close to maximum, not 50% of the maximum.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

7. Claims 1, 4-5, 8-9, 11, 15, 17-18, and 40-46 are rejected under 35 U.S.C. 102(a) as being anticipated by US Patent Publication 20020160585 by Park et al., hereafter Park.

Park discloses a method for forming a film by ALD method including exposing the first precursor dose to the substrate, thereafter exposing the wafer to the second chemically reactive group to provide a uniform coating (figures, 0086). Park discloses supplying a first and second reactant without a purge, multiple times, and discloses a

first reactant for 0.5 seconds and a second reactant for 1 second (0086, figures). Park discloses TMA and H₂O as the reactants respectively (0086).

Park discloses all that is taught above, as for the requirement regarding the second precursor exhibiting saturating characteristics, however, as discussed above, Park discloses the claimed TMA and H₂O and therefore at least the first precursor exhibits saturating characteristics as required by the claim. Park fails to disclose the requirement of film growth rate at a maximum value. However, the Park teaches each and every process step and limitation of the applicant's claims, including the length of time for introducing the precursors into the process chamber as well as the claimed reactants. Since the dose that results in maximum growth rate as in the applicant's claimed process is disclosed as simply a function of the precursors utilized and the length of pulses, and Park teaches the claimed process steps (including equivalent times and process gases), Park would have inherently produced a dose sufficient to results in a film growth rate at a maximum value unless essential process steps and/or limitations are missing from the applicant's claims.

Park fails to disclose a dose of the first or second precursor insufficient to result in maximum deposition rate or starved deposition. However, the Park teaches each and every process step and limitation of the applicant's claims, including the length of time for introducing the precursors into the process chamber as well as the claimed reactants. Since the dose insufficient to result in maximum deposition by the applicant's claimed process is disclosed in the disclosure as simply a function of the precursors utilized and the length of pulses, and Park teaches the claimed process steps, Park

would have inherently produced a dose insufficient to result in maximum deposition unless essential process steps and/or limitations are missing from the applicant's claims.

Since the dose that results in maximum growth rate as in the applicant's claimed process is disclosed as simply a function of the precursors utilized and the length of pulses, and Park teaches the claimed process steps (including equivalent times and process gases), Park would have inherently produced a dose sufficient to results in a film growth rate at a maximum value unless essential process steps and/or limitations are missing from the applicant's claims. The mere observation of still another beneficial result of an old process cannot form the basis of patentability. *Allen et al. v. Coe*, 57 USPQ 136; *In re Maeder et al.* 143 USPQ 249. Therefore the fact that Park does not explicitly state that the process gases are supplied at a dose that results in maximum saturated deposition rate does not disqualify the reference because Park does disclose the claimed process steps (including equivalent times and process gases). At the very least selecting dose so as to reap the benefits of a maximum deposition rate would have been obvious to one of ordinary skill in the art to reap the benefits of increase film deposition efficiency and thus increase throughput, a substantial benefit desired in the semiconductor processing industry.

Claims 2-3: These claims are discussed above.

Claims 4-6: Park discloses repeating first and second precursor pulses without a purge between them (0086).

Claims 8-9: Park discloses purging between reactive gases is known and suitable in the ALD art (0022). The selection of something based on its known suitability for its intended use has been held to support a *prima facie* case of obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Claim 11: Park discloses TMA and H₂O as the reactants respectively (0086).

Claim 15: Park discloses a first reactant for 0.5 seconds and a second reactant for 1 second (0086).

Claim 17: Park discloses delivering reactants substantially uniformly over the wafer (figures).

Claim 18: Park discloses repetition of first and second reactants (0086).

Claims 40-41: Park discloses times that are taught by the applicant as operable times for achieving the deposition and therefore Park must necessarily disclose times less than that as taught by conventional ALD method. See also discussion with regards to 35 USC 112 2nd paragraph above.

Claim 42: Park discloses a uniform film and the same gases/times as claimed and therefore it is the examiners position that the film as taught by Park will have the uniformity as claimed unless the applicant is performing process steps that are not presently claimed.

Claims 43: Park discloses a showerhead as claimed (see figures, where a gas distribution means as taught by Park can reasonably be considered a showerhead as claimed).

Claim 44: Park discloses all the process steps as claimed, i.e. Park discloses a uniform film and the same gases/times as claimed and therefore it is the examiners position that the saturated deposition rate of the TMA as taught by Park will have the same properties as those claimed unless the applicant is performing process steps that are not presently claimed.

Claim 45: Park discloses no purge between the substrate, i.e. a minimum controllable tolerance time.

Claim 46: This claim is rejected for the same reasons as set forth above with regards to the maximum deposition rate.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 1, 4-5, 8-9, 11, 15, 17-18, and 40-46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park as taught above in view of Matero et al. (Effect of water does on the atomic layer deposition rate of oxide thin films).

Park discloses all that is taught above and while the examiner maintains the position with regards to the process of Park inherently having the features as claimed because the references discloses all the same precursors and times that the

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specification discloses as providing the claimed benefits, the examiner cites here Matero et al., which explicitly discloses that the dose of water (i.e. the first precursor that has a longer saturation time) and TMA are result effective variables for depositing a aluminum oxide film, directly effecting the deposition rate of the film (see entire reference). Additionally, Matero discloses film uniformity for doses that are less than saturation (page 1) and therefore it would have been obvious to one skill in the art at the time of the invention was made to determine the optimal value for the precursor doses, including time, used in the process of Park, through routine experimentation, to provide the desired deposition rate taking into consideration the pulse times and the desired throughput. Additionally, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to provide H₂O and TMA at the claimed pulse doses, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). Additionally, the examiner notes the process as taught by Matero includes times that are well within the disclosed ranges as claimed and deposition rates that are substantially within the range as claimed.

Additionally, adjusting the precursor doses to achieve the maximum film deposition rate would have been obvious to one of ordinary skill in the art to reap the benefit of improved throughput.

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DAVID TUROCY whose telephone number is (571)272-

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2940. The examiner can normally be reached on Monday-Friday 8:30-6:00, No 2nd Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/David Turocy/
Patent Examiner, Art Unit 1792